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(54) **APPARATUS AND METHOD FOR IDENTIFYING, BASED ON AN ALTERNATING PATTERN, A PORT TO WHICH A CABLE IS CONNECTED**

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CPC . **H04L 49/20** (2013.01); **H04L 5/16** (2013.01)  
USPC ..... **370/230**; **370/252**; **370/282**; **709/224**

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**709/208-209**, **217-229**, **248-250**  
See application file for complete search history.

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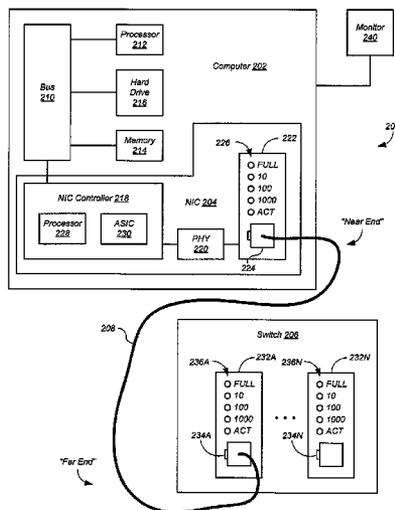
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(57) **ABSTRACT**

A switch includes a connector, a port, and an indicator. The connector is configured to connect via a cable to a computer. The port is attached to the connector. While the connector is connected to the computer via the cable, the port is configured to: transmit a command signal from the switch to the computer via the cable, wherein the command signal requests identification of the port; and detect a response to the command signal as received from the computer. The indicator is connected to the port. The indicator is configured to identify the port based on an alternating pattern of the response to the command signal.

**20 Claims, 4 Drawing Sheets**



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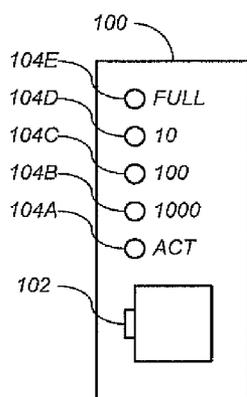
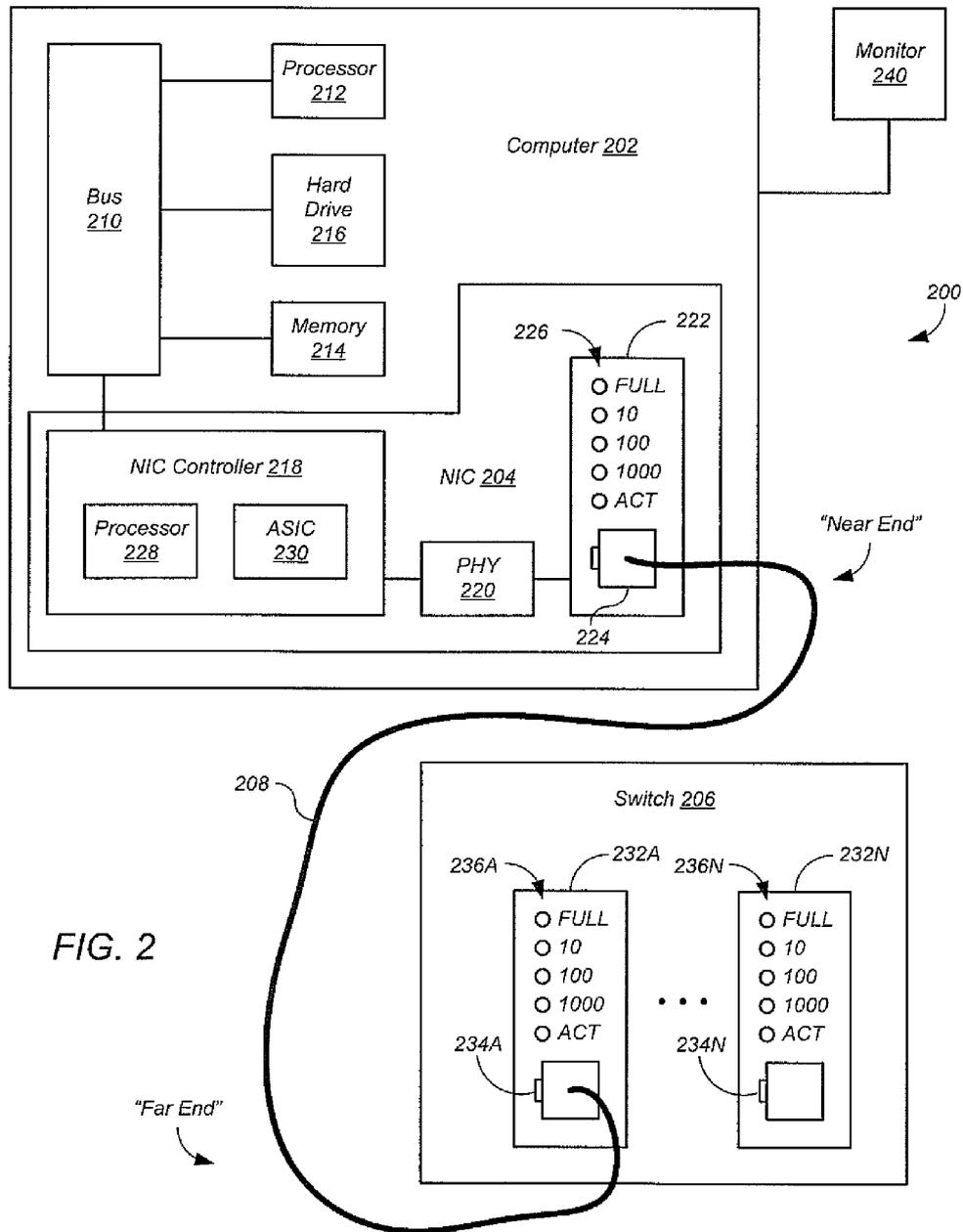


FIG. 1  
Prior Art



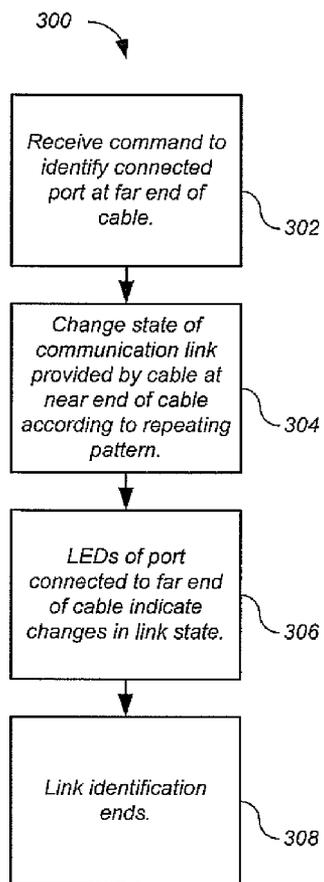


FIG. 3

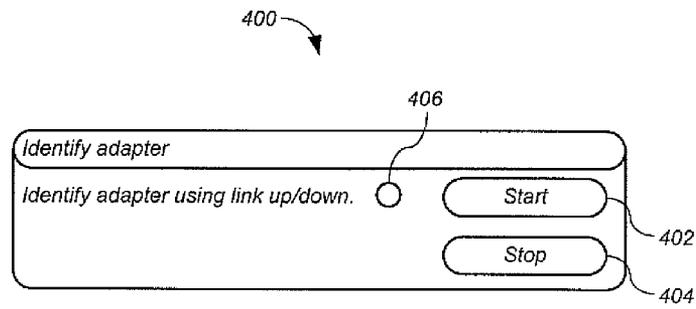


FIG. 4

**APPARATUS AND METHOD FOR  
IDENTIFYING, BASED ON AN  
ALTERNATING PATTERN, A PORT TO  
WHICH A CABLE IS CONNECTED**

CROSS-REFERENCE TO RELATED  
APPLICATIONS

The present disclosure is a continuation of U.S. patent application Ser. No. 13/099,036 (now U.S. Pat. No. 8,493,864), filed on May 2, 2011, which is a continuation of U.S. patent application Ser. No. 12/260,527 (now U.S. Pat. No. 7,936,671), filed Oct. 29, 2008. This application claims the benefit of U.S. Provisional Patent Application Ser. No. 60/987,225, filed Nov. 12, 2007. The entire disclosures of the applications referenced above are incorporated herein by reference.

BACKGROUND

The present disclosure relates generally to data communications over cable. More particularly, the present disclosure relates to identifying the port connected to the far end of a cable using a device connected to the near end of the cable.

In a typical office, devices such as personal computers, printers, and the like are connected to a corporate network by cables such as Ethernet cables. Each cable is generally connected to one or more switches, which are located away from the devices, for example in a separate room. Each switch has many ports, each connected to one of the cables. In such a system, one problem commonly encountered by a network administrator is how to visually identify the switch port to which a particular device is connected.

Some network configuration utilities include a function to identify the local network card using a flashing LED. However, this function only helps to identify a specific network port of a local device with several network cards installed. The function is unable to identify a port connected to the far end of a cable connected to the local device.

SUMMARY

A switch includes a connector, a port, and an indicator. The connector is configured to connect via a cable to a computer. The port is attached to the connector. While the connector is connected to the computer via the cable, the port is configured to: transmit a command signal from the switch to the computer via the cable, where the command signal requests identification of the port; and detect a response to the command signal as received from the computer. The indicator is connected to the port. The indicator is configured to identify the port based on an alternating pattern of the response to the command signal.

In other features, a method is provided and includes connecting, via a connector, a switch to a computer via a cable. The method further includes, while the connector is connected to the computer via the cable: transmitting a command signal from a port of the switch to the computer via the cable, where the port is attached to the connector and the command signal requests identification of the port; and detecting a response to the command signal as received from the computer. The method also includes identifying the port via an indicator and based on an alternating pattern of the response to the command signal. The first indicator is connected to the first port.

In general, in one aspect, an embodiment features a method comprising: receiving a command to identify a connected

port at a far end of a cable providing a communication link; and changing a state of the communication link at a near end of the cable according to a repeating pattern in response to the command.

Embodiments of the method can include one or more of the following features. In some embodiments, the state of the communication link includes at least one of: link activity up/down status; link speed; and link half/full duplex status. Some embodiments comprise displaying an indication of the repeating pattern on a monitor at the near end of the cable. In some embodiments, the command indicates the repeating pattern. In some embodiments, the cable is an Ethernet cable. In some embodiments, the cable is selected from the group consisting of: a USB cable; a IEEE 1394 firewire cable; an ISDN cable; an analog telephone cable; a digital telephone cable; and an optical cable.

In general, in one aspect, an embodiment features an apparatus comprising: a first port to connect with a near end of a cable providing a communication link; and a controller to change a state of the communication link at the near end of the cable according to a repeating pattern in response to a command to identify a second port connected with a far end of the cable.

Embodiments of the apparatus can include one or more of the following features. In some embodiments, the state of the communication link includes at least one of: link activity up/down status; link speed; and link half/full duplex status. Some embodiments comprise a monitor at the near end of the cable to display an indication of the repeating pattern. In some embodiments, the command indicates the repeating pattern. In some embodiments, the cable is an Ethernet cable. In some embodiments, the cable is selected from the group consisting of: a USB cable; a IEEE 1394 firewire cable; an ISDN cable; an analog telephone cable; a digital telephone cable; and an optical cable. Some embodiments comprise a network device comprising the apparatus. In some embodiments, the network device is selected from the group consisting of: a network switch; a router; and a network interface controller. Some embodiments comprise a computer comprising the network device.

In general, in one aspect, an embodiment features a computer program comprising: instructions for receiving a command to identify a connected port at a far end of a cable providing a communication link; and instructions for changing a state of the communication link at a near end of the cable according to a repeating pattern in response to the command.

Embodiments of the computer program can include one or more of the following features. In some embodiments, the state of the communication link includes at least one of: link activity status; link speed; and link half/full duplex status. Some embodiments comprise instructions for displaying an indication of the repeating pattern on a monitor at the near end of the cable. In some embodiments, the command indicates the repeating pattern. In some embodiments, the cable is an Ethernet cable. In some embodiments, the cable is selected from the group consisting of: a USB cable; a IEEE 1394 cable; an ISDN cable; an analog telephone cable; a digital telephone cable; and an optical cable.

In general, in one aspect, an embodiment features an apparatus comprising: first port means for connecting with a near end of a cable providing a communication link; and controller means for changing a state of the communication link at the near end of the cable according to a repeating pattern in response to a command to identify a second port connected with a far end of the cable.

Embodiments of the apparatus can include one or more of the following features. In some embodiments, the state of the

communication link includes at least one of: link activity status; link speed; and link half/full duplex status. Some embodiments comprise monitor means, at the near end of the cable, for displaying an indication of the repeating pattern. In some embodiments, the command indicates the repeating pattern. In some embodiments, the cable is an Ethernet cable. In some embodiments, the cable is selected from the group consisting of: a USB cable; a IEEE 1394 cable; an ISDN cable; an analog telephone cable; a digital telephone cable; and an optical cable. Some embodiments comprise a network device comprising the apparatus. In some embodiments, the network device is selected from the group consisting of: a network switch; a router; and a network interface controller. Some embodiments comprise A computer comprising the network device.

The details of one or more implementations are set forth in the accompanying drawings and the description below. Other features will be apparent from the description and drawings, and from the claims.

### BRIEF DESCRIPTION OF DRAWINGS

FIG. 1 shows a port for a conventional network device.

FIG. 2 shows a data communications system according to one embodiment.

FIG. 3 shows a process for the data communications system of FIG. 2 according to one embodiment.

FIG. 4 shows an “Identify Adapter” window that can be used to generate a command to begin link identification according to one embodiment.

The leading digit(s) of each reference numeral used in this specification indicates the number of the drawing in which the reference numeral first appears.

### DESCRIPTION

The subject matter of the present disclosure relates to identifying the port connected to the far end of a cable using a device having a port connected to the near end of the cable using link state indicators of the far-end port. In a typical network device, one or more link state indicators is provided for each port. For example, each port may have one or more light-emitting diodes (LEDs) to indicate the state of the link associated with the port. In embodiments of the present invention, these indicators are manipulated using repeating patterns so the far-end port can easily be identified. The manipulations of the far-end indicators is done using the default communication protocol between both peers. The far end peer does not need any special hardware or software to be able to show the manipulated pattern.

FIG. 1 shows a port **100** for a conventional network device. Referring to FIG. 1, port **100** includes a connector **102** for connecting a cable to provide a communication link, and LEDs **104A-E**. LEDs **104** indicate the link state of the link for port **100**. LED **104A** indicates the link activity state, that is, whether the link is up or down. LEDs **104B-D** indicate the link speed in Mb/s. LED **104E** indicates the duplex state of the link, that is, whether the link is full duplex or half duplex.

While a user device such as a computer or printer may have only one port, a switch generally has many. When a network administrator is troubleshooting a link at the switch, it can be difficult to identify the switch port connected to a particular device. To solve this problem, embodiments of the present invention manipulate the link state at the device, which is connected to the “near end” of the cable, so as to produce a repeating pattern in the LEDs at the switch port connected to the “far end” of the cable. The pattern is selected to be sig-

nificantly different from normal operation patterns, and therefore easily recognizable to humans, so that the network administrator can identify the switch port for the device at a glance.

FIG. 2 shows a data communications system **200** according to one embodiment. Data communications system **200** includes a computer **202** that includes a network interface controller (NIC) **204** connected to a switch **206** by a network cable **208**. While various embodiments are described with respect to computer **202**, and NIC **204**, they are equally applicable to other sorts of devices such as printers, scanners, routers, switches, and the like. In addition, while various embodiments are described with respect to network communications, they are equally applicable to devices employing other forms of data communications, which can use different signaling protocols, such as direct links and the like. For example, while in the described embodiments cable **208** is an Ethernet cable, in other embodiments, cable **208** can be a USB cable, a IEEE 1394 cable (also known as firewire), and the like. In addition, cable **208** is not limited to electrical cables, and in other embodiments can be an optical cable or the like.

As another example, data communications system **200** can be a telephone system where computer **202** is replaced by a telephone and cable **208** can be an Integrated Services Digital Network (ISDN) cable, an analog telephone cable, a digital telephone cable, or the like. In such embodiments, visual indicators (such as LEDs) can be augmented or replaced by audible indicators such as specific ringtones which are not used during normal operation and the like.

Referring to FIG. 2, computer **202** includes NIC **204**, which is connected by a bus **210** to a processor **212**, a memory **214**, and a hard drive **216**. NIC **204** includes a controller **218**, a physical-layer device (PHY) **220**, and a port **222**. Port **222** includes a connector **224** and LEDs **226**, which can be arranged as shown for port **100** of FIG. 1. In various embodiments, controller **218** includes a processor **228**, an ASIC (application-specific integrated circuits) **230**, or both.

Switch **206** includes a plurality of ports **232A-N**, each including a respective one of connectors **234A-N** and a respective group of LEDs **236A-N**. Cable **208** is connected to port **232A** of switch **206**, as shown in FIG. 2. For clarity, the end of cable **208** connected to computer **202** is referred to as the “near end,” while the end of cable **208** connected to switch **206** is referred to as the “far end.” LEDs **236A-N** at the “far end” may be different in alignment, number, and color from LEDs **226** at the “near end”. Data communications system **200** can also include a monitor **240** connected to computer **202**.

FIG. 3 shows a process **300** for data communications system **200** of FIG. 2 according to one embodiment. Although in the described embodiments, the elements of process **300** are presented in one arrangement, other embodiments may feature other arrangements. For example, in various embodiments, some or all of the steps of process **300** can be executed in a different order, concurrently, and the like.

Referring to FIG. 3, computer **202** receives a command to identify the connected port **232** at the far end of cable **208** (step **302**). In some embodiments, the command is generated by a local user. For example, the user can employ a graphical user interface of the operating system of computer **202** to generate the command.

FIG. 4 shows an example “Identify Adapter” window **400** that can be used to generate the command to begin link identification according to one embodiment. Referring to FIG. 4, window **400** includes a “Start” button **402** that can be

used to generate the command. Once far end port identification is complete, a "Stop" button 404 can be used to stop link identification.

In some embodiments, the command can be generated by a remote user. For example, a window similar to window 400 of FIG. 4 can be displayed to a network administrator at a remote computer.

In response to the command, computer 202 changes a state of the communication link provided by cable 208 at the near end of cable 208 according to a repeating pattern (step 304). For example, as indicated by example window 400 of FIG. 4, the state change can be making and breaking the link. This and other state changes can be employed, alone or in combination, for example by changing the link speed, the link half/full duplex status, and the like. The repeating pattern can be, for example, changing the link state every 1-3 seconds.

In some embodiments, the command indicates the repeating pattern. For example, the user can select different patterns using different link states. In other embodiments, the pattern is predetermined.

The visual or audible indicators at the "far end" and the "near end" may generate different patterns due to different hardware or software on both sides. For example, the alignment, number, or color of the LEDs 226 may be different from the LEDs 236A-N so that both sides may show different patterns.

The changes in link state are indicated by LEDs 226 of the port 222 connected to the near end of cable 208. The changes in link state are also indicated by the LEDs 236 of the port 232 of switch 206 connected to the far end of cable 208 (step 306). LEDs 236 can flash, change color, or the like. The repeating pattern should be chosen so that the changes in LEDs 236 are significantly different from normal operating patterns, and therefore easily recognizable by the human eye. For example, when the link is made and broken every 3 seconds, the ACT LED 236 of the connected port 232 of switch 206 should flash in a pattern that repeats every 3 seconds.

In some embodiments, an indication of the repeating pattern is displayed on monitor 240. For example, referring to FIG. 4, window 400 can include an indicator 406 that can show a preview of the visual pattern (such as flashing, changing color, or the like) in the manner expected at the far end of cable 208, thereby making identification of the connected far end port even easier. In other embodiments, indicator 406 can generate audible indications to preview an audible pattern.

In some embodiments, link identification ends automatically (step 308). For example, process 300 can end automatically after one minute. Ending automatically is especially useful when link identification is initiated remotely using the link being identified. Alternatively, a user can end link identification using "Stop" button 404 of FIG. 4.

Process 300 of FIG. 3 can be implemented in hardware, software, or combinations thereof. For example, software can be stored in memory 214 and or hard drive 216 of computer 202, as well as in a memory of NIC 204, and can be executed by processor 212 of computer 202, processor 228 of NIC 204, or both. As another example, hardware can be implemented in ASIC 230 of NIC 204.

Various embodiments can be implemented in digital electronic circuitry, or in computer hardware, firmware, software, or in combinations of them. Apparatus can be implemented in a computer program product tangibly embodied in a machine-readable storage device for execution by a programmable processor; and method steps can be performed by a programmable processor executing a program of instructions to perform functions by operating on input data and generating output. Embodiments can be implemented in one or more

computer programs that are executable on a programmable system including at least one programmable processor coupled to receive data and instructions from, and to transmit data and instructions to, a data storage system, at least one input device, and at least one output device. Each computer program can be implemented in a high-level procedural or object-oriented programming language, or in assembly or machine language if desired; and in any case, the language can be a compiled or interpreted language. Suitable processors include, by way of example, both general and special purpose microprocessors. Generally, a processor will receive instructions and data from a read-only memory and/or a random access memory. Generally, a computer will include one or more mass storage devices for storing data files; such devices include magnetic disks, such as internal hard disks and removable disks; magneto-optical disks; and optical disks. Storage devices suitable for tangibly embodying computer program instructions and data include all forms of non-volatile memory, including by way of example semiconductor memory devices, such as EPROM, EEPROM, and flash memory devices; magnetic disks such as internal hard disks and removable disks; magneto-optical disks; and CD-ROM disks. Any of the foregoing can be supplemented by, or incorporated in, ASICs (application-specific integrated circuits).

A number of implementations have been described. Nevertheless, it will be understood that various modifications may be made without departing from the scope of the disclosure. For example, the disclosed techniques can be used for any communications where a link will be established between two peers. Accordingly, other implementations are within the scope of the following claims.

What is claimed is:

1. A switch comprising:

a first connector configured to connect via a cable to a computer;

a first port attached to the first connector, wherein, while the first connector is connected to the computer via the cable, the first port is configured to transmit a first command signal from the switch to the computer via the cable, wherein the first command signal requests identification of the first port, and detect a first response to the first command signal as received from the computer; and

a first indicator connected to the first port, wherein the first indicator is configured to identify the first port based on an alternating pattern of the first response to the first command signal.

2. The switch of claim 1, wherein:

the alternating pattern of the first response to the first command signal repeatedly transitions between a plurality of states; and

the first indicator is configured to indicate the alternating pattern.

3. The switch of claim 1, wherein:

the first port is configured to detect a communication link, provided via the cable, alternating between a first state and a second state;

the first state refers to the communication link being active; the second state refers to the communication link being inactive; and

the communication link alternating between the first state and the second state is the first response to the first command signal.

4. The switch of claim 1, wherein the first port is configured to, in detecting the first response to the command signal, detect a change in a speed of a communication link provided via the cable.

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5. The switch of claim 1, wherein:  
the first port is configured to detect a communication link,  
provided via the cable, alternating between operating in  
a full duplex mode and a half duplex mode; and  
the alternating of the communication link between operat-  
ing in the full duplex mode and the half duplex mode is  
the first response to the command signal.

6. The switch of claim 1, wherein:  
the first response to the command signal repeatedly  
changes between a first state and a second state; and  
periods between successive states of the first response to  
the command signal have a same predetermined length.

7. The switch of claim 1, wherein the first indicator com-  
prises a plurality of light emitting diodes.

8. The switch of claim 1, wherein the first indicator is  
configured to provide an audible indication of the first port or  
a visual indication of the first port.

9. The switch of claim 1, wherein the indicator:  
is configured to display the alternating pattern while iden-  
tifying the first port; and  
ceases to display the alternating pattern while not iden-  
tifying the first port.

10. The switch of claim 1, further comprising:  
a second connector configured to connect via the cable to  
the computer;  
a second port attached to the second connector, wherein,  
while the second connector is connected to the computer  
via the cable, the second port is configured to  
transmit a second command signal from the switch to the  
computer via the cable, wherein the second command  
signal requests identification of the second port, and  
detect a second response to the second command signal  
as received from the computer; and  
a second indicator connected to the second port, wherein  
the second indicator is configured to identify the second  
port based on an alternating pattern of the second  
response to the second command signal.

11. A method comprising:  
connecting, via a first connector, a switch to a computer via  
a cable;  
while the first connector is connected to the computer via  
the cable,  
transmitting a first command signal from a first port of  
the switch to the computer via the cable, wherein the  
first port is attached to the first connector, and wherein  
the first command signal requests identification of the  
first port, and  
detecting a first response to the first command signal as  
received from the computer; and  
identifying the first port via a first indicator and based on an  
alternating pattern of the first response to the first com-  
mand signal, wherein the first indicator is connected to  
the first port.

12. The method of claim 11, wherein:  
the alternating pattern of the first response to the first com-  
mand signal repeatedly transitions between a plurality of  
states; and

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the first indicator is configured to indicate the alternating  
pattern.

13. The method of claim 11, further comprising, at the first  
port, detecting a communication link alternating between a  
first state and a second state, wherein:

the communication link is provided via the cable;  
the first state refers to the communication link being active;  
the second state refers to the communication link being  
inactive; and

the communication link alternating between the first state  
and the second state is the first response to the first  
command signal.

14. The method of claim 11, wherein the detecting of the  
first response to the command signal comprises detecting a  
change in a speed of a communication link provided via the  
cable.

15. The method of claim 11, wherein the detecting of the  
first response to the command signal comprises detecting a  
communication link, provided via the cable, alternating  
between operating in a full duplex mode and a half duplex  
mode.

16. The method of claim 11, wherein:  
the first response to the command signal repeatedly  
changes between a first state and a second state; and  
periods between successive states of the first response to  
the command signal have a same predetermined length.

17. The method of claim 11, further comprising indicating  
the first response via a plurality of light emitting diodes of the  
first indicator.

18. The method of claim 11, further comprising generat-  
ing:

an audible indication of the identification of the first port  
via the first indicator; or  
a visual indication of the identification of the first port via  
the first indicator.

19. The method of claim 11, further comprising:  
displaying the alternating pattern while identifying the first  
port; and  
ceasing to display the alternating pattern while not iden-  
tifying the first port.

20. The method of claim 11, further comprising:  
connecting, via a second connector, the switch to the com-  
puter via the cable;

while the second connector is connected to the computer  
via the cable,  
transmitting a second command signal from a second  
port of the switch to the computer via the cable,  
wherein the second port is attached to the second  
connector, wherein the second command signal  
requests identification of the second port, and  
detecting a second response to the second command  
signal as received from the computer; and  
identifying the second port via a second indicator and  
based on an alternating pattern of the second response to  
the second command signal, wherein the second indica-  
tor is connected to the second port.

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